SAGE INSTRUMENTS

966R

Next Generation Multi-Channel Remote Test Server

Hardware/Command Line Software

User Manual

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THE 966R is a powerful multi-channel IP Telephony test server designed to provide service providers and manufacturers a robust test patform to remotely monitor, turn-up, and maintain voice, fax and data services.

In today's environment, test tools need to be cost-effective in both form and function. And with it's broad range of instrument quality test features and it's ability to be configured as a single or multi-user platform, the 966R can be shared to meet a variety of requirements in a Next Generation environment.

- Field Certification & Deployment Testing
- Voice Quality Testing
- Tier III Fault Isolation
- Proactive Quality Assurance Testing
- Proactive IMT Testing (ROTL)

Overview

Purpose

The 966R is a powerful remote multi-channel IP Telephony precision test instrument combining TDM, Ethernet and Analog interfaces and simultaneous test capability to comprehensively test and monitor Next Generation Networks in Real-Time.

- ***Voice Processing & IP Telephony Transparency design verification***
- ***VoIP service readiness, turn-up testing, and trouble shooting***
- ***Voip security monitoring***

The 966R can generate one or many end-to-end test calls from the packet, TDM, and/or Analog interfaces while monitoring the bearer channel (TDM, RTP, Analog) to flush out real-time performance issues.

- Passively and/or actively detect & measure AUDIO LEVELS & ECHO
- Assess voice quality - MOS, DELAY, NOISE, etc.
- Qualify Echo Cancellers - Dispersive Echo and programmable delay
- Verify FAX/data modem transparency
- Verify VAD, Jitter Buffer, Comfort Noise, and silence suppression
- Emulate Fax and True IP phones with jitter buffers and real RTP
- Filter, decode and analyze RTP/RTCP
- Detect and monitor rogue/illigal VoIP calls

Whether you are a Next Generation operator or designer, the 966R reduces rollout and design cycle time for new packet voice services.

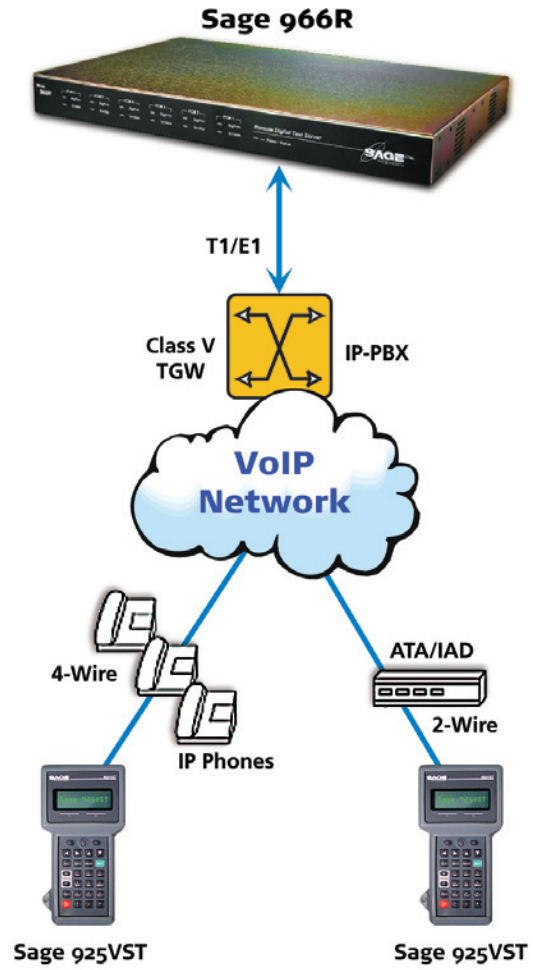
Applications and Capabilities

966R features a powerful Next Generation Voice Suite

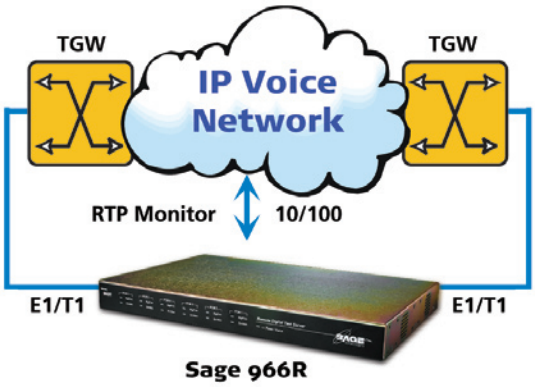
Echo Cancellation Performance

- Passive Echo Monitor (INMD ITU-P.561)
- Multi-Echo Detection
- Echo Level, Echo Delay
- Echo Canceller Disabler Tone(s)
- Dispersive Echo Emulation
- Double Talk Test and Emulation
- Echo Cancellation Convergence Testing
- Echo Cancellation Depth
- G.168 Test Suite and Echo Can Control

Typical Applications and Configurations



Edge Network Service Qualification
(End-to-End Voice Quality & Troubleshooting)



Packet Tandem & LD Network
(Voice Quality, Fax & Data Transparency)

Applications and Capabilities *(continued)*

Voice Quality and Telephony Transparency
- Mean Opinion Score (MOS)
- One-way and Round Trip Delay
- Comfort Noise Level (CNG)
- Audio Level (Gain/Attenuation)
- Jitter Buffer Performance
- Packet/Frame Loss (% Average burst length)
- DTMF/MF Verification
- Fax Transparency
- V.xx Modem Transparency
- RTP Traffic Generation
- Call Loading

Digital Facility Turn-up & Validation
- Multi-Channel BERT and Fractional E1/T1

Test Interfaces
- Two T1/E1 - 48/64 Simultaneous Tests
- Four T1/E1 - 96/124 Simultaneous Tests
- Dual 0/100 BT - 128 Simultaneous Tests
- Quad 2-wire FXO
- Dual 4-wire Dry

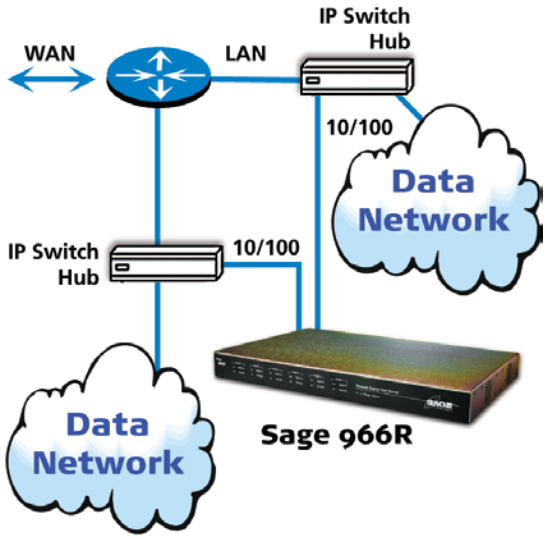
Call Setup Signaling
- CAS • PRI-ISDN • SIP

Passive Monitor
- SIP Call Monitor
- RTP decode and Monitor
- RTCP decode and Monitor
- Echo Level and Delay
- PRI-ISDN Call Monitor

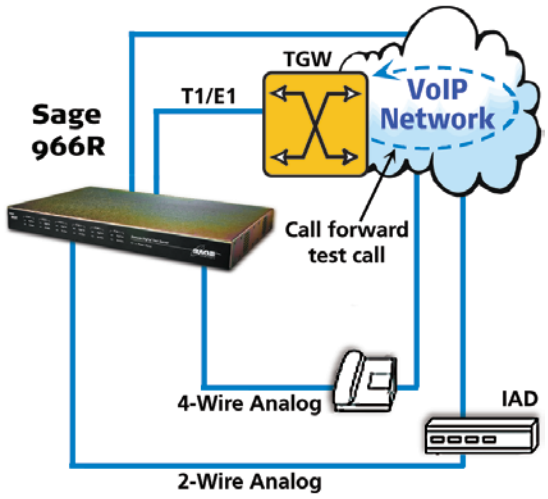
Standard Features
- Send/Measure Tone, Spectrum Analyzer
- Graphical User Interface PC Software
- PCM Data Capture
- Channel Selectable Remote and Local Audio Monitor
- Programmable Pass/Fail Parameters

Physical Characteristics
- Test Interface: 2/4 T1 or E1 Ports
- Bantam, BNC (Dual Mon, D&I, Term)
- Dual 10/100 BaseT, RJ-45 (Half, Full)
- Four 2-Wire FXO, RJ-11
- Two 4-Wire Dry, RJ-22
- Com Port: 10/100 BaseT, USB 1.0
- Power 120/240VAC; UL, CE
- Com Port: Single USB, Series B Receptacle
- Size 10" x 4 "x 14.5", max wt. 10 lbs.
- Operating Temp 0-40 Degrees C

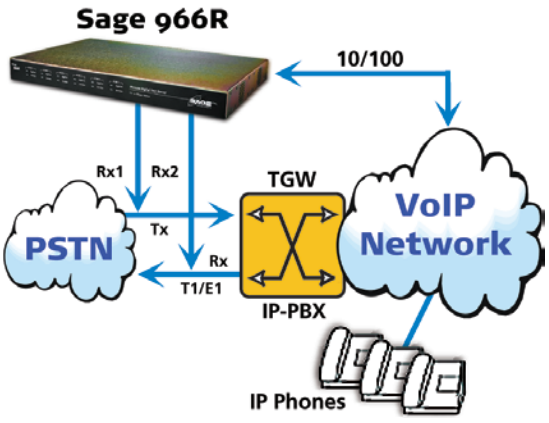
Typical Applications and Configurations (continued)



VoIP Pre-Qualification
(Generate and Monitor SIP and RTP Traffic)



Access Gateway Design Verification
(Delay, Clarity, Echo Cancellers, etc.)
Generate, decode and Monitor SIP & RTP/RTCP



VoIP Pre-Qualification
(Generate and Monitor SIP and RTP Traffic)

966R Options

Sage 966R options are sold separately. Please contact your Sage sales representative for pricing and availability.
831-761-1000 (press 2).

Part Id	Description
7966-0100-02	Dual E1/T1 programable interfaces
7966-0200-02	Quad E1/T1 programable interfaces
7966-0300-02	Dual Ethernet programable interfaces
7966-0400-02	Dual 2-Wire & 4-Wire Analog Interface
7966-0450-02	Quad 2-Wire & 4-Wire Analog Interface
7966-0800-02	Onboard TCP/IP Remote Controller
7966-1000-02	PRI-ISDN Call Setup Protocol
7966-5000-02	ITUG.107 Conversational Quality Test
7966-5100-02	Digit Analyzer
7966-5200-02	ROTL 100, 102, 105 Test Lines & Directors
7966-5300-02	MoIP Test Line & Director
7966-5400-02	BERT - DS0, DS1, FT1, and FE1 BERT
7966-5500-02	NGEN Tests - SMOS, PVIT, Echo Sounder, Echo Generator Test Lines and Directors
7966-5600-02	G.168 Suite - ITU G.168 Echo Canceller Conformance Test
7966-5700-02	INMD - ITU P.561 Passive Echo Monitor
7966-5800-02	Fax - T.30 Transmit & Reciever Emulation
7966-6110-02	SIP Protocol Mon/Decode
7966-6120-02	SIP Call Setup - Orig/Term plus Dual Spectrum Analyzer
7966-6130-02	RTP Mon & Decode plus Dual Spectrum Analyzer
796X-8980-01	One (1) year extended warranty.
796X-8980-02	Two (2) year extended warranty.
796X-8980-03	Three (3) year extended warranty.

It is important to note that the SAGE 966R is a Telnet Command Line Controlled device. With the exception of the "On" and "Off"switch there are no controls of any kind on the 966R unit itself. If the unit is disconnected from the PC outputs are "idled" after 30 seconds.

Intuitive Telnet Command Line User Interface provides Remote Instrument Control with individual control of each bearer channel.

Unpacking

When your new 966R multi-channel test instrument arrives from the factory, the shipping box should contain the following components:

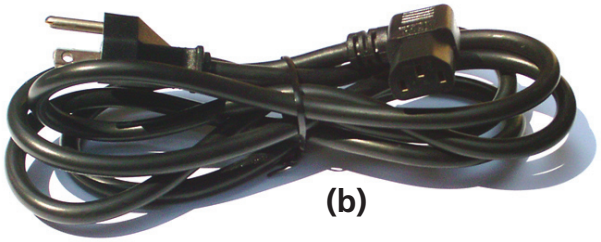
Packout

- SAGE 966R Multi-Channel Test Unit (a)
- Power Cord (b)
- USB Cord (c)
- Software Compact Disk (d)
- SAGE 966R User Manual, supplied on the software installation disk in printable PDF format. (e)

Remove the components from the shipping carton and inspect contents. Notify SAGE Instruments immediately if any damage from shipping is detected.

(d)

(a)



(b)

(c)

(e) Located on the 966R software installation CD in printable PDF format.

966R Software Installation Remote Command

Important Note: *The following instructions only apply to 966R Units Equipped with the Sage TCP/IP Telnet Remote Command Interface.*

Installation

1. To complete this procedure, you must have a Windows 98SE/2000/ME/XP PC compatible computer with a USB port, and the software update file "960Asetup_0578.exe".

Note: Windows 98SE users installing the 966R software for the first time may be prompted to insert their Windows 98 Installation CD. If this prompt appears, the installation will not proceed until software drivers are loaded from that CD.

Warning: *If you are currently running Sage 960 software prior to v5.7.8, your 960 configuration files may no longer be useable due to a file format change. The installation program will automatically create a new one for you.*

Warning: *DO NOT CONNECT the TCP/IP 960x USB port to your PC USB port, yet. If you have previously made that connection while both PC and 960x were powered up, you must first go to the end of this document and complete the section titled "If You Connected the TCP/IP 966R USB Too Soon" before proceeding to step 3 below.*

2. If the 960B is not powered up, turn it on. Do not connect ethernet or USB cables, yet.

3. If 960x software exists on the PC, you must UNINSTALL it now:
   a. Go to Start, Control Panel, Add/Remove Programs, then double-click the Sage 960 entry and follow the on screen instructions.

Note: If a Sage 960 entry does not appear in the PC Add/Remove Programs list, you must manually delete the old 960 program subdirectory and its contents: Using Windows Explorer, navigate to C:\Program Files\Sage Instruments, then delete the subdirectory named "960".

4. Launch the 966R software installer program:
4. Launch the 960 software installer program:
a. Using Windows Explorer, navigate to the subdirectory where you previously placed the 960Asetup_06113eng.exe file
b. Double-click on the file. You may be presented a Security

Note: Depending on your PC operating system version, the installer may prompt you at some point to reboot your PC before continuing with the install.

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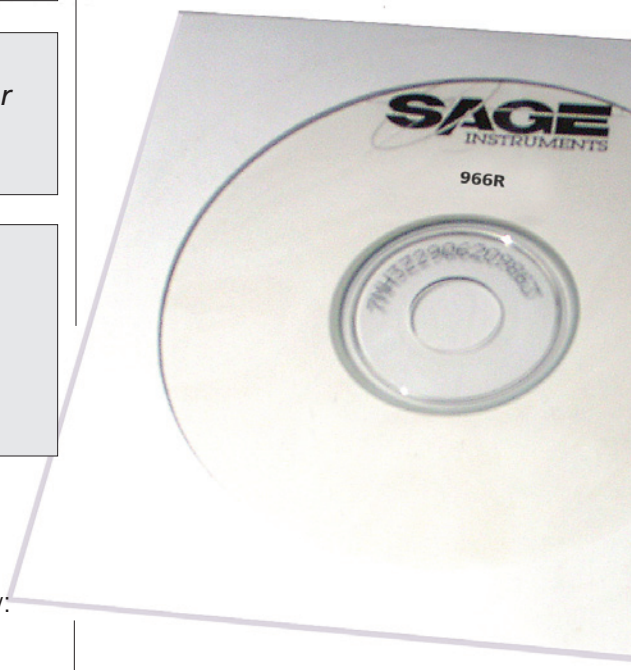


Post Installation

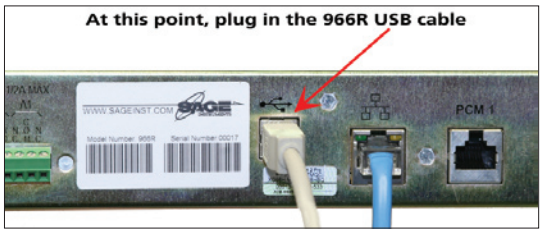
Depending on your PC operating system version, the software installer may prompt you to reboot your PC before continuing with the program.

Once the software installation is complete, you may power up the 966R and conduct tests .

Software Installation

(for 966R TCP/IP Remote enabled units) *(continued)*

c. You will now see a "Sage Instruments" splash screen; click on "Next"
d. You will now see the InstallShield opening screen; click on "Next"
e. The installer will now display the license agreement. Click on "I accept the terms...." then click on "Next"
f. You will now be presented the Customer Information screen. Fill in the User Name and Organization boxes
g. Then, click on "Anyone who uses this computer (all users)" and click on "Next"
h. The installer will now present the Custom Setup screen
i. Click on the drop-down box just to the left of the text "TCP/IP Remote Control", and select "This feature will be installed on local hard drive"



At this point connect your 966R USB Cable

j. Click on "Next"
k. The Ready to Install screen will now appear. Click on "Install"
l. At completion of the installation, click on "Finish"
m. You will see a text file "remoteControlInstall.txt" displayed. Close that window.
n. The software installation will now proceed. When it is done, a new window titled "Set Up Microsoft ActiveSync 3.8" will appear.
o. Click "Next," then click "Next" again. A "Copying File" window will open. The progress bar may pause at "92%" for 30 seconds to several minutes, depending on the speed of your PC.
p. After ActiveSync is installed, you may see a Windows Security Alert box appear. Click on "Unblock"
q. You will now see a "Get Connected" box. Connect the supplied USB cable between your PC and the 960B.
r. The "Found New Hardware Wizard" will appear. Choose ""No, not this time," then click "Next"
s. Choose "Install from a list or specific location," then click "Next"
t. Click on "Include this location in the search"

Note: If the following search path does not appear in the "location" window, CAREFULLY type it in (without quotes): "C:\Program Files\Sage Instruments\960\ce\drivers"

u. Click on "Next". You may see an alert box that warns that the driver has not passed "Windows Logo testing..." Click on "Continue Anyway"
v. Once ActiveSync 'sees' the 960B, it will present a New Partnership dialogue box. Click on "No," click "Next"
w. The Microsoft ActiveSync application window will then appear. It will be obscuring part of the las "Found New Hardware Wizard" window. Click on that "Wizard" window to bring it to the front. Click on "Finish"

5. The software installation is now complete, you may power up the 960 and conduct tests.

If You Connected the TCP/IP 966R USB Cable Too Soon

If you prematurely connected the 966R USB port to your computer, your PC was not able to find the proper "driver" and has disabled communication attempts to the 966R. This section describes how to recover from this situation and relaunch the Windows **"Found New Hardware Wizard"**.

1. If the TCP/IP 960x USB port is still connected to your PC, disconnect it now.
2. In Windows XP, use your PC mouse to click on Start, Control Panel, System, Hardware, Device Manager.
3. In the Device Manager dialog box, look for an **"Unknown USB Device"** preceded by a yellow question mark. Highlight it and press the DEL (delete) key on your keyboard.
4. Close the Device Manager and all its 'parent' windows that opened up on your way there.
5. Now connect the 966R USB cable and the **"Found New Hardware Wizard"** application will launch.

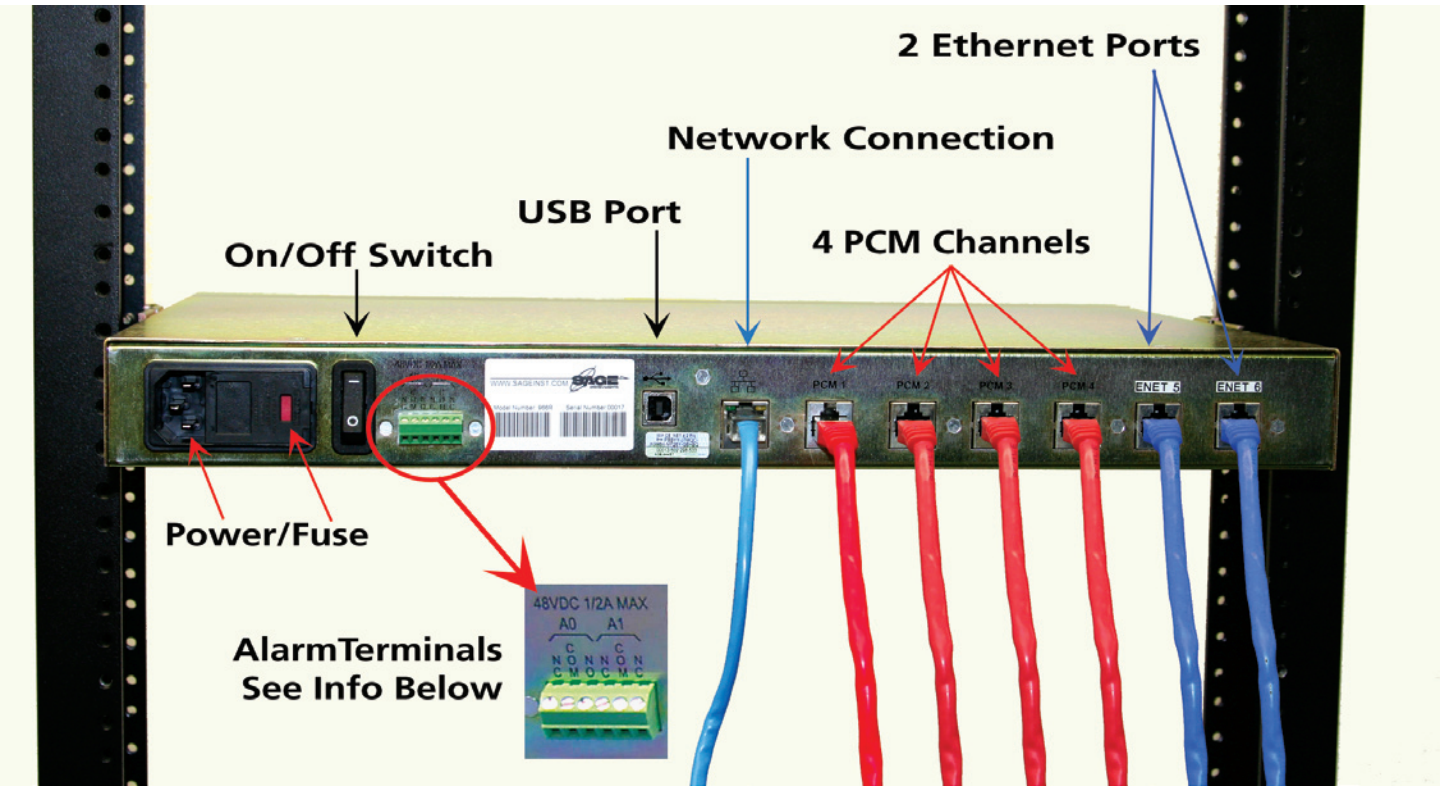
If any questions or problems arise during installation, please call SAGE Technical Support at **(831) 761-1000 ext. 4.**

966R Physical Properties Remote Command Option Enabled

Assigning the 966R IP Address

966R users will need to assign the 966R an IP address and the port identifier. The 966R will accept a static IP address or a Dynamic Host Configuration Protocol (DHCP) address. Provide the 966R IP Address to all users.

966R Rear Panel Connections



Alarm Relays

For connection to central office alarm systems. There are two alarm relays (A0 and A1). Each relay has a normally open (NO) and a normally closed (NC) contact. To configure alarms connect a lead to the common (COM) terminal, and a second lead to the desired (NO or NC) contact terminal.

966R Front Panel

Except for channel activity LEDs the 966R front panel does not have any controls.

Telnet Command Line Remote Access

A. Getting Started
B. Navigating the Console
C. Administering the Sage Device
D. Gathering Information for Conducting Tests
E. Managing Test Results
F. Conducting Tests
G. Starting and Stoping Tests
H. Help Documentation for each Command

A. Getting Started:

1. Log into the console using a telnet terminal window.
2. To get a list of all the commands, type 'help'.

B. Navigating the Console:

Navigation Commands:	
help	Allows all users to access help on the various built-in commands.
cd	Changes the current directory.
dir	Displays current directory contents.
exit	Exits the command interpreter and closes associated network resources

1. Type 'dir' to get a list of all the files and directories in the current directory.
2. To change directories, type 'cd <name of directory>'. If you need to change to the parent directory, type 'cd ..'
3. To exit the console, type 'exit' .

C. Administering the Sage 966R:

Administrative Commands:	
user	Access user information.
useradd	Creates a new user. Admin only.
userdel	Deletes a user. Admin only.
warmstart	Reboots the controller.
version	Displays the command interpreter.
versionpasswd	Change the current user's password.
kick	Terminate a user's session. Admin only.
time	Displays or sets system time
date	Displays or sets system date

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Administrating the Sage 966R *(continued)*

1. To get a list of the users currently logged in, type 'user -a'
2. To get a list of all registered users, type 'user -d'
3. To add a user, type 'useradd <username> <password>'
4. To delete a user, type 'userdel <username>'
5. To reboot the controller, type 'warmstart'
6. To get the command interpreter version, type 'version'
7. To change the current user's password, type 'passwd'
8. To terminate a user's session (as Admin only), type 'user -a' to get a list of users and their associated session ids.
Then, type 'kick <user's session id>' to terminate the user's session.
9. To display the time, type 'time'. To change the time, type 'time <HH:MM:SS>'
10. To display the date, type 'date'. To change the date, type 'date <MM/DD/YYYY>'

D. Gathering Information for Conducting Tests:

Information Commands for Tests:	
intfc	View interface status; configure interfaces.
unit	Display unit information, activate options.

These commands are used to facilitate running the tests.
In order to conduct any of the tests, you will need the information about each interface. To get info about each interface, type 'intfc' You will see a list of numbered interfaces available. To get more details about each interface, type 'intfc <interface number>'

important information about interfaces:
On the 96X Family of products, a 96X Unit is composed of one or more phyical 'interfaces'. An interface could be a PCM span, an ethernet port, or an analog jack. Each interface is composed of one or more 'resources'. For example, a T1 span has 24 resources (channels, in this case), and an analog interface has only one resource. The ethernet interface has a number of resources called 'slots' that allow for the definition of multiple, simultaneous tests on a single interface. Tests are defined at the resource level; if a resource doesn't have a test defined, it is considered an 'idle' resource.

These 'interface' and 'resource' abstractions allow for uniform command, control, and administration of completely different physical media. In this case Ethernet, PCM, and Analog media can all be manipulated via the same commands by specifying only the interface #. Likewise, individual tests are referenced by indicating the interface # and resource #. To allow the different interfaces to be reconfigured with this command, the configuration process is interactive (you will be prompted for appropriate input).

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Administrating the Sage 966R *(continued)*

Important PCM Note: Note that there are two 'flavors' of PRI ISDN supported: the normal PRI_ISDN setting and the PRI_ISDN/Dyn setting. The Dyn setting means 'dynamic' B-Channel selection for responders that define their originating number. When in this dynamic mode, if a call comes in, the responder 'originating' numbers are searched for a match to the incoming destination number. If a match is found, the responder is started on the B-Channel of the incoming call. Otherwise a responder without a originating number is started, if found. The upshot of all this is that in the dynamic ISDN mode, the resource numbers **DO NOT** directly correlate with B-Channels; they are merely test slots as they are on the Ethernet interfaces. As a consequence, in this mode outgoing calls will be put up on arbitrary B-Channels. Furthermore, no indication of the B-Channel in use is available to the user.

Examples:
To show high level status of all interfaces installed in the unit, use: intfc
To show detailed status of a specific interface, say #2, use: intfc 2
To (re)configure, say interface #2, (as Admin or owner of all tests on the interface), use: intfc -c 2

E. Managing Test Results

Test Utility Commands are as follows, and are used to help manage test results.

Test Utility Commands:	
deltest	Delete the specified test.
del	Delete a file
report	Report the latest results for the specified test.
tests	View status of tests
type	Display a file.
remctrl	Switch Unit to UI 'Remote Control' mode.

F. Conducting Tests

Test Commands:	
digrecv	Digit Receiver Test
digsend	Digit Sender Test
echogen	Echo Generator Test
echosnd	Echo Sounder Test
faxrx	FAX Receiver Test
faxtx	Fax Transmitter Test
inmd	INMD Test
moipd	MoIP Director Test
moipr	MoIP Responder Test
pvit	PVIT Test
smosd	SMOS Director Test
smosr	SMOS Responder Test
smtone	Send/Measure Tone Test

G. Starting & Stoping Test

Test Utility Commands:	
start	Start the specified test
stop	Stop the specified test
10xd	10x Director Test
10xr	10x Responder Test

Now that you have gathered the interface information, you may now conduct tests effectively.

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H. Help Documentation for Each Command

For more information on a specific command, type 'help command-name'. The following is an alphabetical listing of usage and notes for each command.

Log into the console using a telnet terminal window:

To get a list of all the commands, type 'help':

Command: **cd**	
Use	Changes the current directory.
Notes	Supports basic up/down navigation. Understands single '..' or a directory *relative* to and 'below' the current directory.

Command: **date**	
Use	Displays or sets system date. [aDate]
Notes	With no arguments, the system date is returned. Admin may set the system date via the paramter. [aDate] (Optional) MM/DD/YYYY

Command: **del**	
Use	Delete a file.
Notes	Delete the specified file. Filenames must be characters without whitespace.

Command: **deltest**	
Use	Delete the specified test.
Notes	Delete the specified test. Must be test owner or Admin; test must be disabled.

Command: **digrecv**	
Use	Configure Digit Receiver Test
Notes	Create a Digit Receiver test that parses incoming digits.

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Administrating the Sage 966R *(continued)*

Command: **digsend**	
Use	Configure Digit Sender Test.
Notes	Create a Digit Sender test (default: director) that sends digits once the call is up. Digit parameters do not effect call setup digits, only digits sent after call is up.

Command: **dir**	
Use	Displays current directory contents.
Notes	Simple current directory listing.

Command: **echogen**	
Use	Configure Echo Generator Test.
Notes	Create a Echo Generator Test (default: responder).

Command: **exit**	
Use	Exits the command interpreter and closes associated network resources.
Notes	None.

Command: **faxrx**	
Use	Configure FAX Receiver Test.
Notes	Create a Fax Receiver test (default: responder).

Command: **faxtx**	
Use	Configure Fax Transmitter Test.
Notes	Create a Fax Transmitter Test (default: director).

Command: **help**	
Use	Allows all users to access help on the various built-in commands.
Notes	For more information on a specific command, type ‘help command-name’.

Command: **inmd**	
Use	Configure INMD Test.
Notes	Create an INMD (passive echo monitor) test. Requires Dual Monitor mode for T1/E1.

Command: **intfc**	
Use	View interface status; configure interfaces.
Notes	Allows all users to view high-level status information on all installed interfaces. Allows a user who owns all the defined tests or ‘Admin’ to (re)configure interfaces.

Command: **kick**	
Use	Terminate a user’s session. Admin only.
Notes	Admin may use the ‘kick’ command to invalidate a stranded or unknown session. The session will terminate when the user sends input over the network connection and is then notified of the impending disconnect; the resources are then reclaimed. Requires the sessionId of the session in question. See the ‘user -a’ command help for details on how to determine the sessionId of other sessions.

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Administrating the Sage 966R *(continued)*

Command: **moipd**	
Use	Configure MoIP Director Test.
Notes	Create a MoIP Director Test.

Command: **moipr**	
Use	Configure MoIP Responder Test.
Notes	Create a MoIP Responder Test.

Command: **passwd**	
Use	Change the current user's password.
Notes	Admin only may change other user's passwords.

Command: **pvit**	
Use	Configure PVIT Test.
Notes	Create a PVIT Test (default: director). Receiver always enabled, sender enabled if a level is specified.

Command: **remctrl**	
Use	Switch Unit to UI 'Remote Control' mode.
Notes	Switch control of the unit from multi-user command line mode to standalone UI remote control. Reboots the controller (but not the interface boards), drops all tests and sessions in progress. This unit is optioned to run in multi-user command line mode as well as single-user remote control via the 960B user interface PC application. Executing this command will: - Kill all network connections to the unit (including this one!!). - Reconfigure the unit for single-user remote control. - Restart the control SW; this will take 30 seconds or so. The Remote Control UI application has provisions to return to the command-line mode, if desired.

Command: **report**	
Use	Report the latest results for the specified test.
Notes	Available to all users; test must be enabled.

Command: **smosd**	
Use	Configure SMOS Director Test.
Notes	Create a SMOS director test that calls a SMOS responder.

Command: **smosr**	
Use	Configure SMOS Responder Test.
Notes	Create a SMOS Responder test that waits for calls a SMOS Director.

Command: **smtone**	
Use	Configure Send/Measure Tone Test.
Notes	Create a Measure Tone test (default: director) that optionally sends a tone.

Command: **start**	
Use	Start the specified test.
Notes	Must be test owner or Admin; test must be disabled.

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Administrating the Sage 966R *(continued)*

Command: **stop**	
Use	Stop the specified test.
Notes	Must be test owner or Admin; test must be enabled.

Command: **10xd**	
Use	Configure 10x Director Test.
Notes	Create a 100, 102, or 105 Director Test.

Command: **10xr**	
Use	Configure 10x Responder Test.
Notes	Create a 100, 102, 105 (default), or 108 Responder Test.

Command: **tests**	
Use	View test status of all tests or just specified interface.
Notes	Resources without defined tests are considered 'idle'. Options allow for filtering results.

Command: **time**	
Use	Displays or sets system time.
Notes	With no arguments, the system time is returned. Admin may set the system time via the paramter. (Optional) HH:MM:SS

Command: **type**	
Use	Display a file.
Notes	Displays the contents of the specified file.

Command: **version**	
Use	Displays the command interpreter version.
Notes	Validate that the Command Language version is correct as the first command after logging in.

Command: **unit**	
Use	Display unit information, activate options.
Notes	Lists detailed unit info. Admin rights req'd to rename the unit or activate new options.

Command: **user**	
Use	Access user information.
Notes	Lists the current logged-in user info. Admin rights req'd to view all defined users.

Command: **useradd**	
Use	Creates a new user. Admin only.
Notes	Creates a new user with the specified password and associated directory. Admin Only.

Command: **userdel**	
Use	Deletes a user. Admin only.
Notes	Deletes an existing user and associated directory. Admin only.

Command: **warmstart**	
Use	Reboot the controller.
Notes	Reboots the controller (but not the interface boards), dropping all tests and sessions in progress.

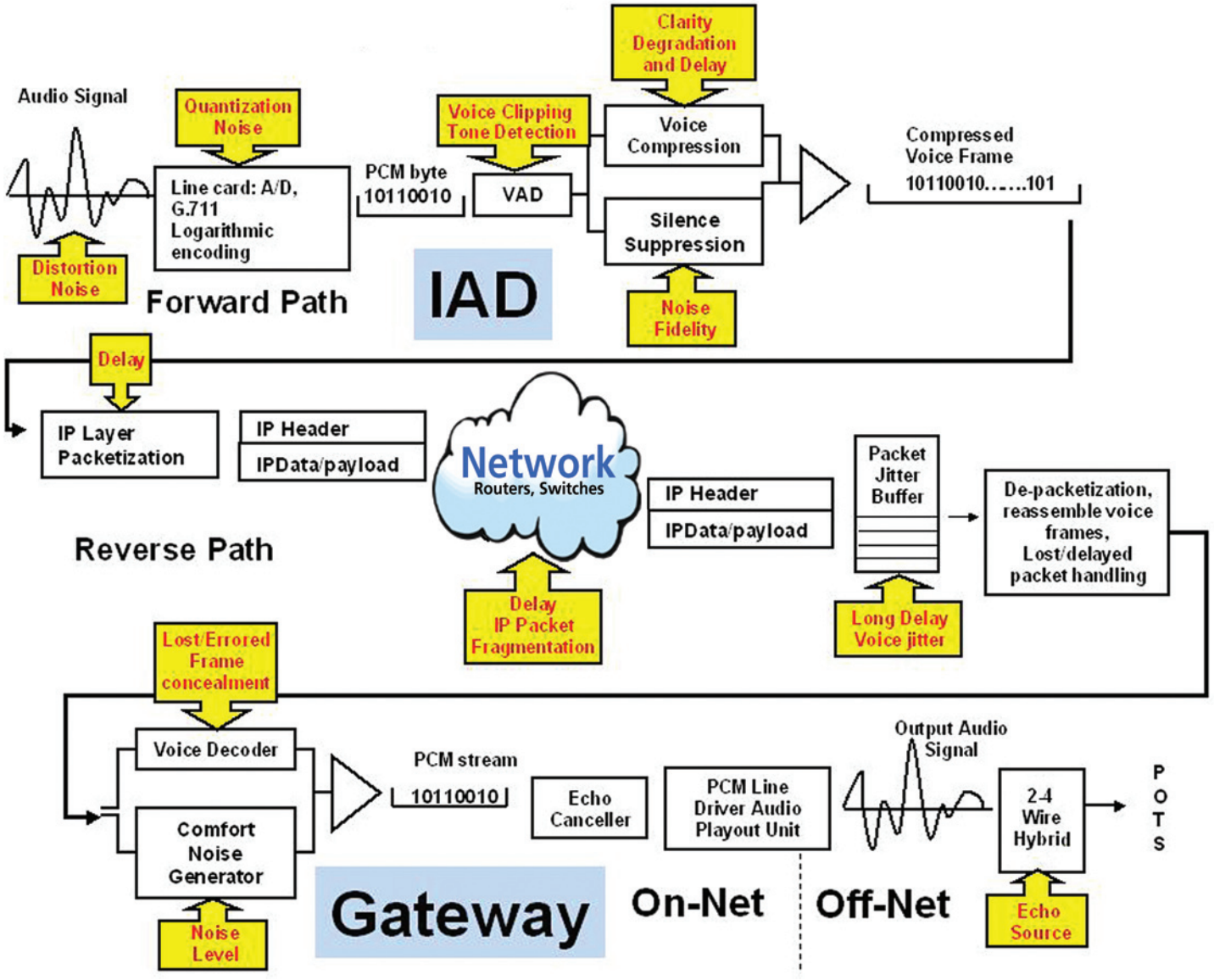
966R Technology and Applications

The 966R IP Telephony Multi-Channel Test instrument is specifically engineered to identify, measure and diagnose all IP Voice processing Impairments. All elements that degrade voice services can be tested and identified with the 966R including:

- **Excessive compression by low-bit vocoders**
- **Voice level too low/High**
- **Excessive packet/cell/frame loss/slip**
- **Excessive voice jitter (Jitter buffer resizing)**
- **Excessive voice clippings (VADs)**
- **Excessive noise (CNG) or not enough**
- **Excessive delay**
- **Echo**

The 966R supports a variety of real-time processing tasks for multiple channels. The following illustrates typical impairments identified with the 966R.

IP Voice Processing Impairments = *Impairments*



SMOS Director/SMOS Responder

Provides End-to-End Voice Quality Characterization. Tests the networks ability to transmit voice distortion free in both directions through gateways, IADs and IP Phones.

Artificial Voice Test Signal (All Accents)

Metrics	*Listener Impact*
Voice Clarity (MOS)	Distortion, Packet Loss
Voice Packet/Frame Slips	Voice Gapping, Jerking
Round Trip Delay	Talk-over
Audio Level	Too Loud or Quiet
Comfort Noise	Too High or Too low
Effective Bandwidth	In-band data qualification
Codec Type Detection	Provisioned incorrectly

PVIT (Packet Voice Impairment Test)

Provides Comprehensive Voice Quality Performance Metrics. Enableing field personnel to zero in on causes of poor voice quality. Considered the DS0 BERT test for VoIP.

Metrics	*Listener Impact*
Voice Clarity (MOS)	Distortion from Packet Loss
+/- Frame Slip Event Count	Voice Gapping and Jerking
Voice Clipping Event Count	Choppy Voice
Noise Hit Event Count	Impulse Noise During silence period

PVIT statistics provided for each event type:

- Average Burst Length (msec)
- Min/Max Burst length (msec)
- Percent of impairment over test duration (i.e. % packet loss)

FAX (Transmit and Receive)

During testing the SAGE 966R FAX emulators will report in real time the test progress, such as what signal is being sent; what signal is being received; whether or not a certain stage is being retried; whether or not an unexpected invalid protocol packet is received; whether or not timing errors have occurred, and whether or not the page transmission has succeeded.

Metrics and Features
Emulate Up to 120 Facsimile Transmitters and Receivers
Stress Gateway for In-band Data Transparency
Terminate Fax on TDM, Packet, and Analog
Decode V.21 (FSK) Two-way Fax Transmission
Support Data Rates for V.17 and V.27

(continued on next page)

MoIP (Modem over IP)

The 966R MoIP test objectively measures a packet networkís ability to carry telephony traffic including voice, data, and fax. The test process emulates three modes of operation: Voice, Data, & Fax. MoIP sends appropriate priming tones (i.e. CNG) to provoke tone detection for call type (Data Mode). MoIP tests also generate pseudo random test signals to verify data mode transparency (essentially 64 KB/s). Fax & Data modems use vulnerable FSK signaling (V.21).

MoIP Test	*Metrics*
Voice	Audio Level, Frame Loss, Frame Jitter (+/-), Codec Type and Round Trip Delay
Data	Frame Loss, Frame Jitter (+/-), Codec Type, and Round Trip Delay
Fax	Frame Loss, Frame Jitter (+/-), Codec Type, and Round Trip Delay

Digit Analyzer

Digit Tests	*Function/Results*
DTMF/MF Digit Verification	Next Gen Nets Encode & Decode Digits On/Off Times, Frequency & Level Detects ANSI Standards and RFC-2833 Digits
Digit Sender Envelope Testing	Settable Frequency and Level and On/Off times Send RFC-2833 Digits

Echo Sounder/Echo Generator

Provides Echo Detection and Echo Canceller verification. Enables field personnel to detect and isolates echo problems from a TDM, 10/100, or Analog interface.
• Echo Generator • Advanced Echo Emulation • Multi-channel to stress embedded echo cancellers

Metrics	*Listener Impact*
Echo Level(s)	Echo Loudness
Echo Delay(s)	As delay gets longer echo becomes more noticeable

Requirements Specified in ITU G.131

INMD (In-Service Non-intrusive Measurement Device) International Telecommunication Union-T P.561

INMD on the 966R platform focuses on echo characterization. More specifically, once the presence of echo is detected, the 966R will report in real time the detected echo level and echo delay. A graphical snapshot of the reference and echo signals is also displayed as further visual confirmation. If the monitored DS1 are PRI-ISDN lines, then the source and destination phonenumbers associated with the monitored DS0 channel are also presented.

Function
ITU P.561 Non-Intrusive VQ Characterization
Passively Detects Echo in both directions via Dual Monitor E1/T1 or RTP Monitor
Monitor up to 60 TDM Channels Simultaneously and/or Up to 256 RTP Streams
Measures and Captures both Echo Level and Delay with Option to Record Audio

(continued on next page)

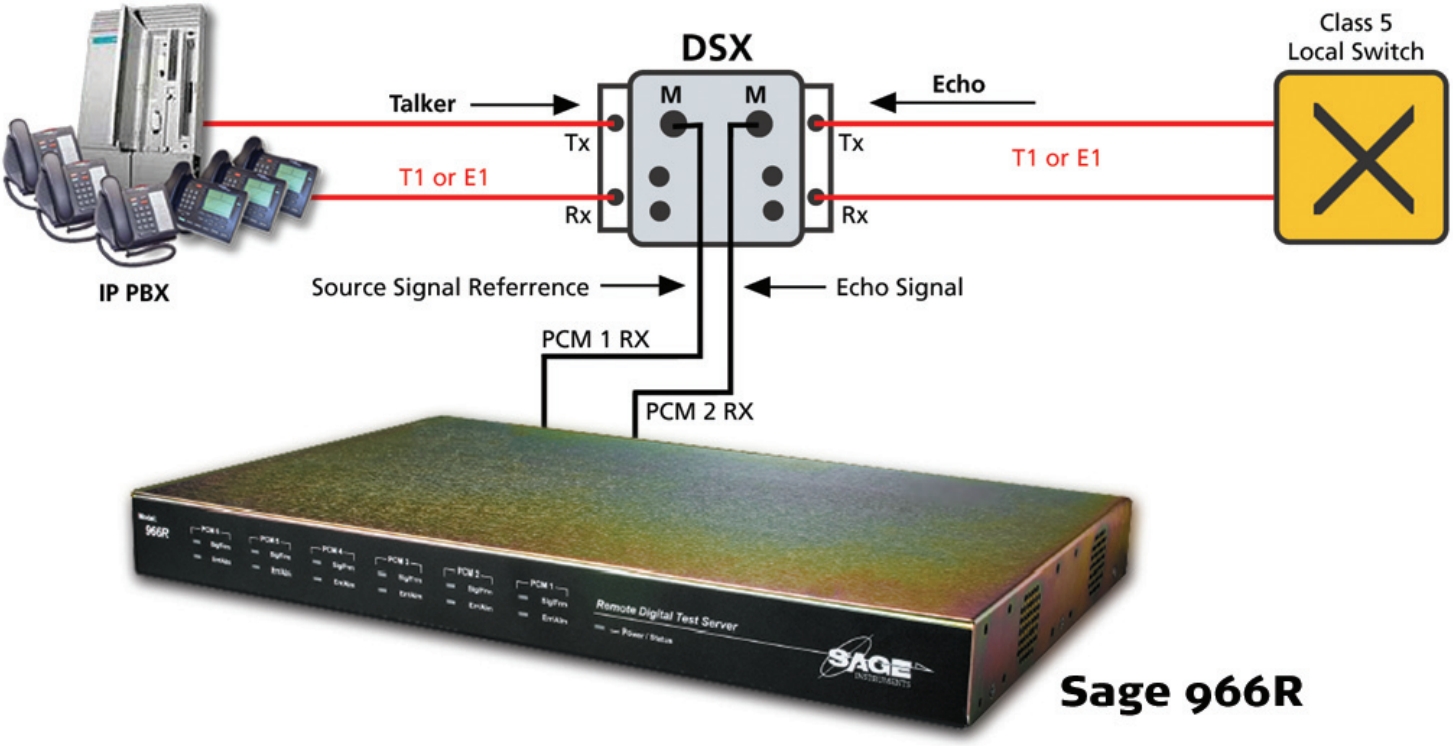
INMD (In-Service Non-intrusive Measurement Device) *(continued)*

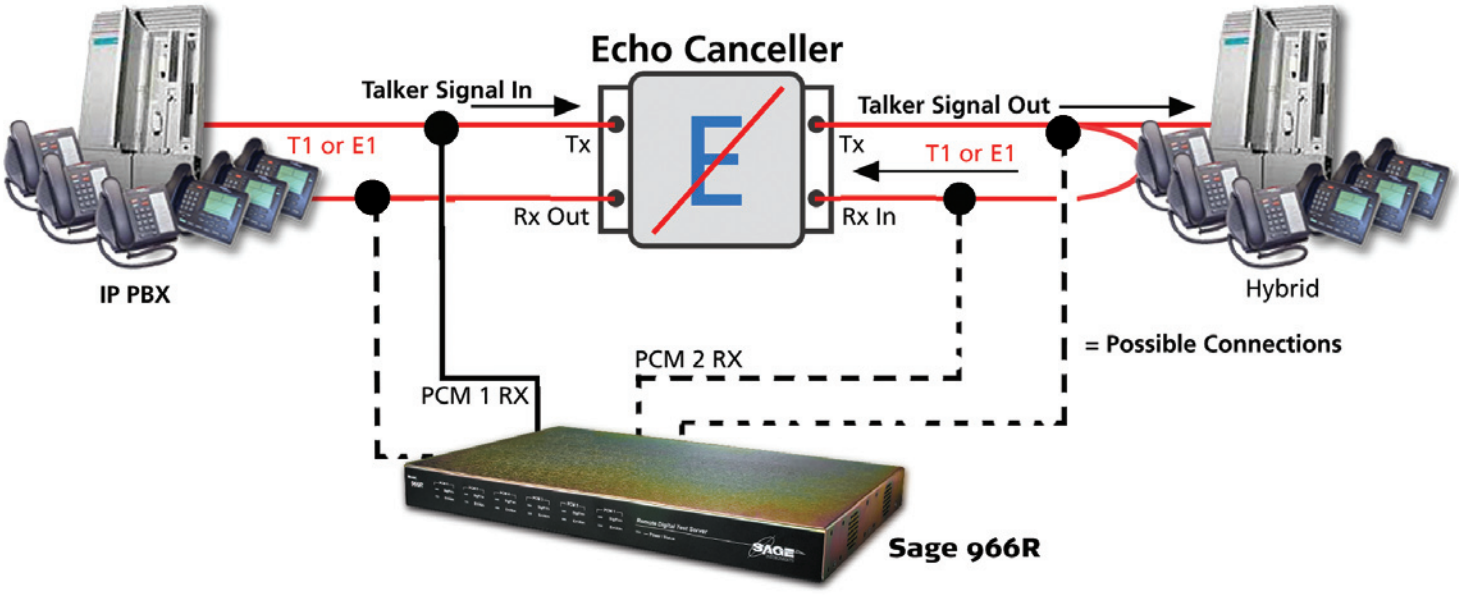
INMD P.561 Passive Echo Monitoring

To run INMD tests ,the SAGE 966R front panel PCM 1 and PCM2 connections need to be paired. Leaving PCM 3 and PCM 4 for connection to the reference signal (see figures 27 & 27a).

Note: For INMD, PCM 1 and PCM 3 must be connected to "Talker" reference signal.

INMD P.561 Typical Configurations





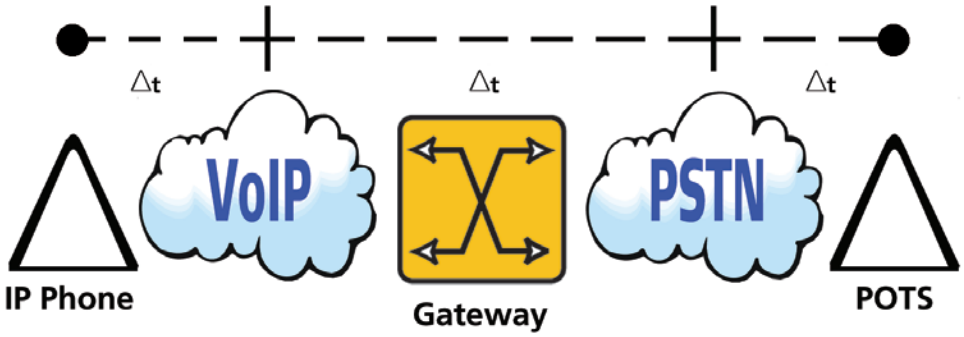
Technology and Applications *(continued)*

One-Way Delay Test

Use the 966R One-Way Delay test to measure one-way delay between disparate telephony interfaces in the lab.

- ***TDM to TDM***
- ***IP to TDM***
- ***TDM to Analog***
- ***IP to Analog***

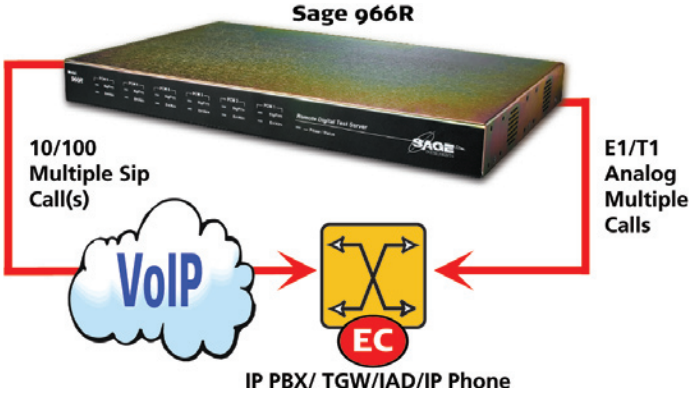
Pinpoint delay issues to segments of the network. Test works with multiple 960 B's as long as the real-time audio ports (mic & spk) are connected.



End-to-End Trunking Gateway

Gateway pass through transparency testing.

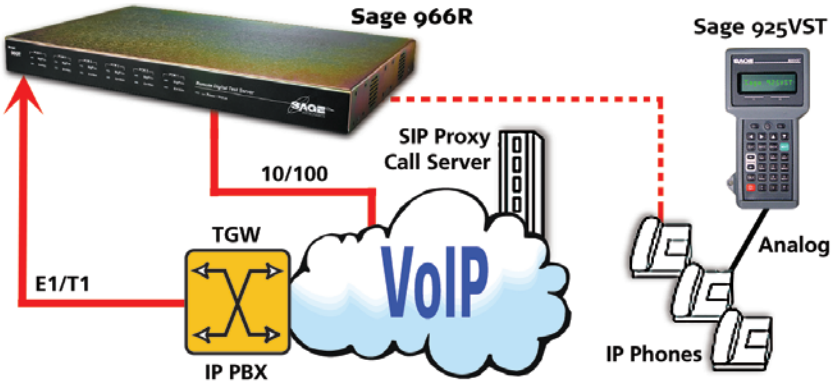
- ***Test Cancellers***
- ***Verify In-band data or T.38 testing***
- ***Voice Quality***
- ***DTMF encoding/decoding (E911 testing)***



Access Gateway

Access Gateway test configuration

- ***Turn-up, and Certification Testing (SIP, RTP MON, TDM Call)***
- ***Voice Quality***
- ***Echo***
- ***Fax***



IXC Long Distance Gateway

LD or Packet Tandem configuration (Class IV)

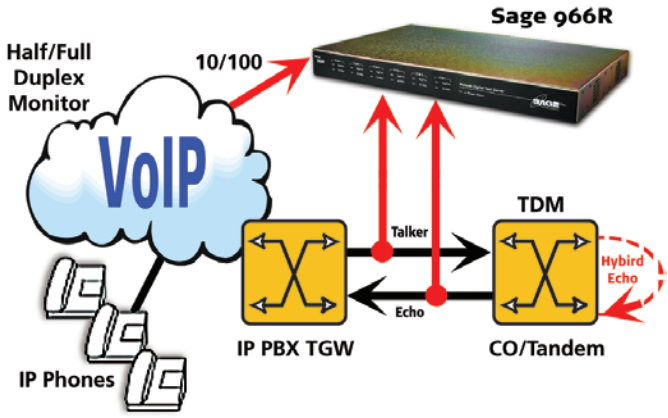
- ***Certification Testing***
- ***Voice Clarity***
- ***Delay***
- ***Echo***
- ***Data***
- ***Fax***

(continued on next page)

Echo Troubleshooting

Passively Monitor Echo, Audio Level and RTP (G.711/G.729)

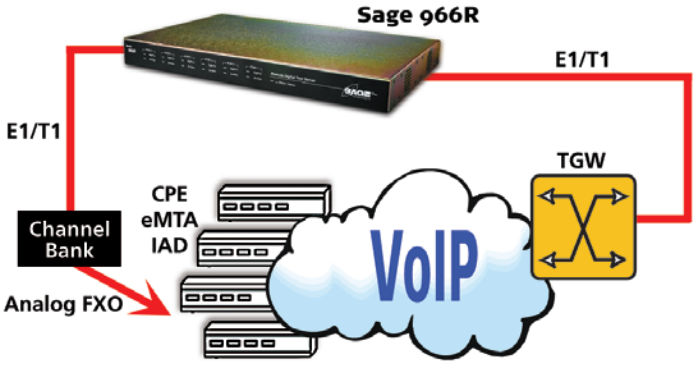
- ***INMD ITU P.561 (Level and Delay)***
- ***Monitor 100's of channels simultaneously***



CPE/QA/Cert Testing

Functional Customer Premise Equipment (CPE) Testing

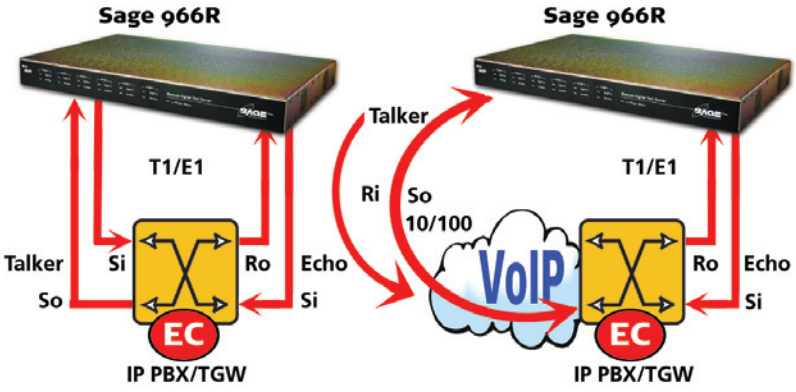
- ***Regression or parametric testing***
- ***Functional testing for Clarity, Delay, Echo, Fax and Data***
- ***Multiple channels via FXO channel bank***



Canceller Performance

Echo detection & canceller performance testing

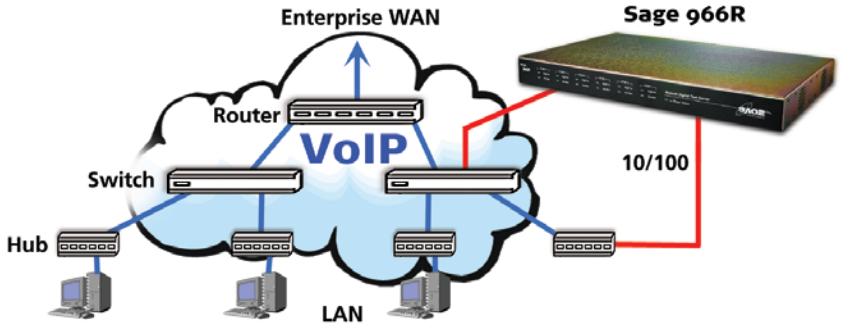
- ***Complete Echo and Double-Talk Emulation (with ITU Standard Dispersive Hybrid Models)***
- ***G.168 Test Suite Manual or Automated Modes***
- ***Test Cancellers over Multiple Channels***



VoIP Pre-Qualification

Place multiple SIP calls to access readiness (up to 128 in full duplex mode)

- ***Test Segments and Backplanes***
- ***Emulate Real IP Phones with Jitter Buffers***



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SAGE Online Referrence Material

SMOS (Sage Mean Opinion Score) White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/900series/SMOS-Spec.pdf

Packet Voice Impairment Test White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/925/pvitwp1.pdf

Echo Sounder & Echo Generator White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/925/ecegwp1.pdf

New IP Telephony Transparency Test, MoIP, Fax, Data & Voice White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/moip.pdf

Fax Emulator Test White Paper via www.sageinst.com located at:
http://www.sageinst.com/downloads/960A/faxtrx6_04.pdf

P.561 INMD Test White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/inmd.pdf

G.168 Test Suite White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/925/g168wp.pdf

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CT Labs Chooses Sage for IP Phone Testing
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SAGE has developed and delivered the industry's most comprehensive solution for Next Generation bearer channel testing.
SAGE Next Generation Voice quality suite provides engineers the most effective way to test and measure gateway and IAD performance in the lab as well as in the field VoIP service from the customer premise.
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SAGE 966R Tests Control/Error States

Run State, Call Control Status

All tests have two states: the Run state, and the Call state. For example, a stopped test would report "Stopped(Idle)" indicating that the test is stopped and the call state is idle. A running test would say "Running(Call Up)", indicating that the run state is "Running" and the call state is "Call Up". The Test Status is also used to message the user with important test state information.

The following are the possible Run States and descriptions:

Normal Run States:	
Status Message	**Description**
Stopped	The test is not running
Cycling or Recycling Test	The test is starting or restarting
Pause or Pause with duration	The test is pausing prior to start (allows responders to recycle)
Running	The test is considered to be running
Stopping	The test is stopping (call is being torn down, etc.)
Make Call	The call is being set up for the test
Wait for Call	A responder is waiting for a call
Running/Responder (or Running)	Run state for Responder
Hybrid	Echo Generator under active G.168 Control
Manual Dial...	The user is manually sending digits
Load aLaw, Load uLaw, or Load Wav and % done	The test is sending the associated PCM file to the DSP

Error States:	
Status Message	**Description**
Error: DSP Error State	Certain tests indicate that they are in Error and need to be restarted
Span In Alarm...	The PCM span is not healthy. Tests are stopped
Can't Connect	The call failed; the test never started
Channel Blocked	The requested channel is no longer available
Error: Test won't start!	The DSP did not report the test started
Error: Test won't stop!	The DSP continues to report the test running in Stopped state
Error: Wrong DSP Test!?	The wrong test is running on the DSP
Error: DSP Test Died!	The test was running, but it suddenly stopped
Too many SMOS Tests!	The User attempted to run too many SMOS tests, so some were terminated to protect the PCM stream

(continued on next page)

SAGE 966R Tests Control/Error States *(continued)*

Call Control Normal States:	
Status Message	**Description**
Acquire Channel	ISDN, Making Call -- Acquire necessary resources for call
Acquire Digits	The far end is expected to send digits, near end waits for them.
Acquire Dial Tone	Waiting for dial tone
Connect	Call up state for FXS/FXO calls
Call Up	Call up state
Dial, Dial Digits	Dialing digits
Dial Tone	Same as Acquire Dial Tone
Hook Off	Command near hook off
Hook On	Near hook is commanded on prior to going off hook, in case it wasn't on to begin with
Hook On(1s)	Wait for 1 second in the hook on state to avoid false signaling transients
Idle	No call is up; no intent to put one up
Initiate(0)", etc.	Initiate States indicate the beginning of a particular call sequence
Loop Closure?	FXO, Ground-start, NT, Making Call -- waiting for far end to answer
Measure Wink	Measure a wink sent by far end
Near Hook Off	Near hook commanded OFF
Near Hook On(180), etc.	Command near hook ON
Ring?	FXO, Loop start, NT, Making Call -- Sending ringing signal, waiting for FXS to answer
Ring Down	FXS/FXO, wait for "Ringing" to go away after 'Tripping the Ring' (answering the call)
Ring Ground?	FXO, Ground-start, NT, Making Call -- waiting for 'ring ground' from FXS (far) side
Send Dial Tone	NT, issue dial tone to far end
Setup Call	ISDN, Making Call -- Issue actual ISDN Call Setup message
Tip Ground?	FXS, Ground-Start, Waiting for 'Tip-Grounding' from FXO side
Wait Connect	Call setup is done on our side, wait for far end to finalize
Wait 4 Call	PRI ISDN, TE, Answer Call -- waiting for call setup message
Wait 4 Hook Off	Near is answering a call, waiting for far hook off, which means a call is incoming (if wink start, set near hook off to start a wink)
Wait 4 Hook On	Near is answering a call, first make sure far hook is ON
Wait for Ring, Wait Ring	FXS/FXO Answer call, waiting for incoming 'ringing' state
Wait Tip-Ground	FXS, Ground-start, TE, Answer Call -- Need to see Tip-ground state before proceeding
Wait for Wink	Wait for the far end to send a wink to the near end
Wink Off	Command near hook off as part of a wink
Wink", "Wink On	Command near hook on as part of a wink
Call Control Error States:	
Far-End Busy	
User Aborted	
No Wink	
Wink too Long	
Far End Abort	
No Answer	
PCM/Frame Loss	
No Dial Tone	

Configuring and running 966R Tests

Send/Measure Tone Test

Sage's Send/Measure Tone is a test feature that enables sending and receiving a user specified tone. Send/Measure tone is useful in measuring the difference in level from sending to receiving end-to-end points. The tone level can be observed via the spectrum analyzer.

Specifications

Tone Test Transmit

Composite Level: -40 to 0 dBm
Individual Tones: Level: -13.6 dB below composite level
Flatness: ±0.2 dB
Frequencies: 203.125-3640.625 Hz in 156.25 Hz steps, ±10 ppm
Phase per IEEE 743 ±0.25∞
Peak to RMS Ratio 8.79

Tone Test Receive

Range:-40 dBm to -6 dBm
Accuracy: ±0.2 dB

Note: All command line entries are typed as characters without whitespace.

Note: When inserting a WAV file, the maximum file length should be no more than 256K samples or approximately 32 seconds of raw PCM (a-Law or μ-Law), 8 Khz encoding at 8, 16, or 32 bits.

Create a Send/Measure Tone tesst

Command: **smtone**	
Parameters	smtone [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-dur] [Tx Freq] [Tx Level]
-dn	destination(Optional)
-sn	source #(Optional)
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional)
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-dur	Test Duration(s) {0}(Optional) 0 to 86400
Tx Freq	[Tx Freq] (Optional) 20 to 3980
Tx Level	[Tx Level] (Optional) -60 to 3

Examples:

Create a smtone responder on interface #2, resource #3 that answers a call, sends a tone at 1004Hz at -12 dBm until the far end hangs up. *smtone -if 2 -rn 3 -resp 1004 -12*

Create a smtone responder on interface #2, resource #3 that answers a call, sends a tone at 1004Hz at -12 dBm for 20 seconds and then hangs up. *smtone -if 2 -rn 3 -resp -dur 20 1004 -12*

Create a smtone director on the first available resource of interface #1 that calls '831-761-1000', sends tone for 12 seconds at 440Hz, -3 dBm and logs any measured (returned) tone to mtone.log.
smtone -if 1 -dn 8317611000 -dur 12 -log mtone.log 440 -3

Create a smtone director on the first available resource of interface #1 that calls '831-761-1000' and logs any measured tone to mtone.log for 12 seconds. No tone sent.
smtone -if 1 -dn 8317611000 -dur 12 -log mtone.log

SMOS Director Test

Purpose and Function

The Sage Instruments Mean Opinion Score (SMOS) test provides an accurate assessment of how telephone users perceive speech quality over a live VoIP network. SMOS provides a comprehensive set of measurements that pertain to all aspects of voice quality. The SMOS test uses a robust algorithm to deliver accurate results in the presence of jitters, band limitations, and dropouts, producing both near-to-far and far-to-near measurements.

SMOS Measurements

- Clarity - Mean Opinion Score (MOS)
- Effective Bandwidth - % available in the 300 Hz to 3400 Hz range
- Voice Frame Slips - compressive and expansive jitters in milliseconds
- Comfort Noise Level - measured in dBrnC during silent period
- Gain - audio level change measured in dB
- Codec Type - detects and reports codec type used
- Delay - round trip measured in milliseconds
- Call Completion Time - completion time measured in seconds

Create an SMOS director test

Command: **smosd**	
Parameters	smosd [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [Duration (sec) {9}]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-dur	[Duration (sec) {9}] (Optional) 0 to 255

SMOS stands for Sage (Instruments) Mean Opinion Score. SMOS provides an automated, fast, convenient and accurate end-to-end assessment of voice quality for any VoX applications. SMOS follows the automated responder test format and employs robust in-band telemetry and synchronization withtrue real-time processing. The test can be conveniently used in both laboratory environments as well as across a real telephone network. SMOS was developed largely out of Sage's prior experience with PSQM and PVIT. SMOS provides an accurate MOS score that truly matches human perception even in a live VoP network where certain impairments such as voice jitters (sudden delay variations or frame slips) and attenuation distortion may render other voice quality tests such as PSQM inapplicable. SMOS contains a reliable Bark-domain partial equalization along with asymmetric masking to properly account for attenuation distortion, and a robust de-jittering algorithm to remove and simultaneously measure any voice jitters (sudden delay variations). The psychoacoustic core is based on the work of Wang et al, Zwicker et al and Sage's own internal research. Besides the MOS number, SMOS also provides a set of other 'orthogonal' measurements that are vitally important in determining the overall voice quality of a network, or trouble-shooting the configuration and traffic engineering of a problematic network. These measurements are orthogonal to MOS because they are not properly reflected in the MOS number, yet they are also important indicators of the overall QoS of the network.
Other measurements are round-trip delay, codec type, effective bandwidth, voice-band gain, silence noise level,

(continued on next page)

SMOS Director Test *(continued)*

SMOS Tests	Range
Director or Responder	1 to 12 SMOS director/responder tests can be RUN simultaneously on a single TDM interface.

Specifications

SMOS Signal	
Artificial Voice	per ITU-T P.50
Active Speech Level	-20 dBTLP

SMOS Measurement	Range	Accuracy
MOS	1.00 to 5.00	+/- .05
Noise	0 to 90 dBrnC	+/- 1 dB
Frame Slips	0 to 2000 msecs	+/- 1 msec
Effective Bandwidth	0.0 to 99.9%	+/- .2%
Gain	-80 to +20 dB	+/- 1 dB
Delay	0.0 to 5000.0 msec	+/- .2 msec
Codec	See "Codec Types tolerates up to Detected"	15% packet loss

Codec Types Detected	
SMOS Test Result	**Codec Type Description**
VCD4K	Sub-4kbs vocoders
VCD8K	5-8kbps vocoders
VCD16K	12-16kbps vocoders
ADPCM16	16kbps G.726 ADPCM
ADPCM24	24kbps G.726 ADPCM
ADPCM32	32kbps G.726 ADPCM
ADPCM40	40kbps G.726 ADPCM
ADPCM	G.726 ADPCM with unknown data rates
PCM	G.711 μ/A-law PCM or pure analog
UNSURE	Distortion prevents codec type detection

SMOS Test Parameters	Range	Default
Test Duration	3 to 60 seconds	10 seconds
Send TLP	-30.0 to +10.0 dBm	0.0 dBm
Receive TLP	-30.0 to +10.0 dBm	0.0 dBm

total amount of compressive jitters (positive frame slips or shortening of delays) and the total amount of expansive jitters/frame slips (lengthening of delays).

SMOS measures an objective Mean-Opinion-Score between 1 and 5. 5 means perfect and 1 means the worst. For all practical measurements, the upper limit of MOS will be between 4.5 and 4.6.

A MOS number between 3.0 to 4.0 is considered to be communication quality (intelligible but unnatural, or could be annoying and lack of speaker recognition etc). A MOS number below 3.0 is unacceptable for voice communication. In a typical VoP (Voice-over-Packet) network, the measured MOS number largely reflects speech degradation caused by the following likely impairments:

1. Lossy voice coder compression.
2. Packet loss and voice clipping.
3. Voice jitters in active voice period.
4. Interference signal and noise.
5. Excessive attenuation distortion.

Example:

Create a smosd test director that runs 10 times on interface 4 resource 14,calls 234-234-8873, and logs the results to smos.csv:
smosd -dir 10 -if 4 -rn 14 -dn 2342348873 -log smos.csv

SMOS Responder

Purpose and Function

The Sage Instruments Mean Opinion Score (SMOS) test provides an accurate assessment of how telephone users perceive speech quality over a live VoP network. SMOS provides a comprehensive set of measurements that pertain to all aspects of voice quality. The SMOS test uses a robust algorithm to deliver accurate results in the presence of jitters, band limitations, and dropouts, producing both near-to-far and far-to-near measurements.

Create a SMOS Responder test that waits for calls a SMOS Director.

Command: **smosr**	
Parameters	smosr [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
Note: After Configuration is complete enter the command [start] . **To view results of the SMOS Responder test configure the same channel on a different PCM for a SMOS Director test.** See director side for results.	

Example:

Create a SMOS responder that answers incoming calls on interface #1 resources 1-5:
smosr -if 1 -rn 1-5

Packet Voice Impairment Test (PVIT)

PVIT provides detailed diagnostic information about events that impact voice clarity over packet switched networks, including: voice frame losses, voice frame slips (also know as jitters), voice clippings and noise hits

Purpose and Function

PVIT works by sending a complex test signal over the network, and measuring events that degrade that signal. The PVIT signal is a carrier-modulated spread spectrum signal with silence insertion.

- Measures four types of impairment events
- Displays cumulative event counts in real time
- Displays details about events as they occur
- Accumulates data over the test period

Test Duration 15 minutes, 1 hour, 24 hours, or continuous (NOTE: The continuous up to 1000 hours)

Command: **pvit**	
Parameters	pvit [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-dur] [-mask] [Tx Level (dBM)]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-dur	Test Duration (s) {0}(Optional) 0 to 1000
-mask	[-mask] Mask (ms) {0}(Optional) 0 to 1000
Tx Level	[Tx Level (dBM)] (Optional) -20 to 0

PVIT stands for Packet-Voice-Impairments-Test or Packet-Voice-Integrity-Test. It is one of a series of VQT (Voice-Quality-Test) tests designed by Sage to specifically address the next generation VoP (Voice-over-Packet) applications. Other related VQT tests available from Sage are SMOS and Echo Sounder. PVIT measures such packet network impairments as packet loss, voice clipping, jitter and comfort noise level. Unlike other impairments such as delay, echoes and lossy voice compression/transcoding which are static in nature and are not necessarily unique to VoP (PSTN also has these problems), the packet loss, voice clipping and jitter type of impairments are unique to VoP and are dynamic in nature. By using PVIT to objectively monitor these dynamic impairments at a regular basis, one can assure the consistence of QoS (Quality-of-Service). For meaningful PVIT results, the reciever must detect a valid PVIT signal. This can be from another PVIT transmitter or it's own signal looped back. The transmitter is off by default but is enabled when a send level is specified.

Examples:

Create a PVIT test responder that sends at -10dBm (and receives) the signal on interface #2 resources 11-18:
pvit -resp -if 2 -rn 11-18 -10

Create a PVIT test director that calls 782-9293 using interface #3 resource #13,sends the PVIT signal at -12 dBm for 15 seconds and logs to pvit.csv. Repeats 5 times.
pvit -dir 5 -dur 15 -if 3 -rn 13 -dn 7829293 -log pvit.csv -12

(continued on next page)

PVIT Test Real Time Metrics

Totals and Events Tabs

The Totals tab displays a group of **metrics** that are near-end metrics of count average and percentage captured during measurement. The Events tab displays near-end results showing individual impairment events. Users have the ability to toggle between totals and events by clicking on the tabs (see figure 68).
The results for metric Totals are displayed in a table of 8 rows and 4 columns In the first row are two fields, one for "Send Level" or Transmit level and "Elapsed Time" (see example below) the remaining rows display test data. The cells 0 or 0.00 depicted in grey are buttons that not only display data, but when clicked control the graphic representation of that buttons data message (see close-up figure 69).

Send Level:		**Elapsed Time:**	
	Counts	**Avg.**	**%**
Frame Loss:	**0**	**0.00**	**0.00**
+Frame Slips:	**0**	**0.00**	**0.00**
-Frame Slips:	**0**	**0.00**	**0.00**
Net Slips:	**0**	**0.00**	**0.00**
Noise Hits:	**0**	**0**	
Voice Clips:	**0**	**0.00**	

Frame Loss: Packet/Frame Loss Includes total elapsed test time, net total PL/FL impairment time, PL/FL event count, PL/FL Average and PL/FL % of total time.

Positive Packet/Frame Slips: A measure of voice signal compression (jerking). Includes total elapsed test time, net total +PS impairment time, +PS event count, +PS/FS Average and +PS% of total time.

Negative Packet/Frame Slips: A measure of voice signal expansion (gapping). Includes total elapsed test time, net total -PS impairment time, -PS event count, -PS/FS Average and -PS% of total time.

Net Slips: Net slip counts, average and %.

Noise Hits: Transient Impulse Noise; Includes total elapsed test time, noise event count, and average event duration.

Voice Clippings: Includes total elapsed test time, net total VC impairment time, VC event count, and average event duration.

Specifications

PVIT Measurement Precision

- Voice Frame Loss: ±2 ms
- Voice Frame Slip (jitter): ±0.5 ms
- Voice Clipping: ±2 ms
- Noise Level: ±1 dB
- Percentage Voice Frame Loss: ±10% of actual % of frame loss

The results for Events are reported as recorded events. Results include event type, event duration, and time stamp.

Event types can be:
- **IS:** In_SYNC
- **RS:** SYNC Recovered
- **SL:** Signal Lost, SYNC Lost
- **SR:** Signal Recovered
- **PL:** Packet/Frame Loss
- **PS:** Packet/Frame Slip (Delay Variation)
- **VC:** Voice Clip
- **NH:** Noise Hit
- **DC:** Detection of Clock Drift

Echo Sounder

Purpose and Function

Echo is one of the most important quality of service factors in a telephone network. Sage Instruments echo test suite includes a complete set of tools to characterize the level and delay of echoes on a network. It provides an objective measurement of this important aspect of overall voice quality.

Specifications

The Sage Echo Sounder test measures echoes with the following:

- Echo levels and Echo delays
- Round trip delay and Round trip attenuation
- One way delay and One way attenuation

The measurement ranges and precisions of Echo Sounder are shown in the table below. The echo delay ranges differ slightly with different interfaces.

Connection Interface	Echo Level Range/ Precision	Echo Delay Range/ Precision
2-Wire Analog	[-60,20]±1 dB	[7,900]±1ms
4-Wire Analog	[-60,20]±1 dB	[0,900]±1ms
T1/E1	[-60,20]±1 dB	[0,900]±1ms

Create an Echo Sounder Test (default: director).

Command: **echosnd**	
Parameters	echosnd [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-ecd] [-ecf] [-ecl] [-ecmf] [-ecmi] [-ecnc] [-ecpd] [-ecpj] [-silence] [-cycles] [Tx Level (dBM) {-10}]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-ecd	Enable EC Disable Tone(Optional)
-ecf	EC Disable Freq (Hz) {2100}(Optional) 20.00 to 3980.00
-ed	EC Disable Level (dBm) {-12}(Optional) -20.00 to 0.00
-ecmf	EC Disable Mod Freq (Hz) {15.0}(Optional) 0.00 to 500.00
-ecmil	EC Disable Mod Index {0.2}(Optional) 0.00 to 1.00
-ecnc	EC Disable # Cycles {3}(Optional) 1 to 10
-ecpd	EC Disable Phase Duraton (ms) {450}(Optional) 10 to 1000
-ecpj	EC Disable Phase Jump (Deg) {180}(Optional) 0.00 to 180.00
-silence	Silence Duration (sec) {3}(Optional) 0.00 to 180.00
-cycles	Number of Test Cycles {3}(Optional) 0.00 to 180.00
Tx Level	[Tx Level (dBM) {-10}] (Optional) -20.00 to 0.00

(continued on next page)

Echo Sounder *(continued)*

Discussion:

The Sage Echo Sounder test sends a proprietary test signal to characterize echos that may be present on the line under test. It is capable of sending an initial echo canceller disable tone prior to the test signal. Default: no disable signal. The parameters of the disable tone are customizable. The Silence duration determines the leading and inter-test (if num cylcles > 1) silence in seconds. A larger leading silence may be useful if calling a line that is slow to answer. The number of cycles is used to repeat the echo sounder tests multiple times during a single call to look for dynamic changes.

Examples:

Perform a echo sounder test on interface #3 resource #2 using the default values (Tx Level = -10, no EC Disable tone) to destination #434-8794:
echosnd -if 3 -rn 2 -dn 4348794

Perform a echo sounder test on interface #3 resource #2 using the default values (Tx Level = -10, no EC Disable tone) to destination #434-8794 and send the echo canceller disable signal:
echosnd -if 3 -rn 2 -dn 4348794 -ecd

Echo Generator

Sage Instruments Echo Generator generates multiple echoes with programmable echo delay and echo level. When combined with Echo Sounder, Echo Generator facilitates the G.168-type [1] of echo canceller test and the measurements of round-trip delay and round-trip attenuation. When working alone, Echo Generator serves as a simple remotely-programmable loop-back.

- Programmable echoes and levels
- Global echo disable in manual mode
- Facilitates echo canceller tests

Specifications

Circuit Type	Level Range/ Accuracy	Delay Range/ Accuracy	Frequency Range
Analog 2-wire	[-40,9]±0.5 dB	[17,600]±0.5 ms	300 to 3300 Hz
Analog 4-wire	[-60,9]±0.2 dB	[17,600]±0.5 ms	300 to 3300 Hz
Digital T1/E1	[-60,9]±0.2 dB	[12,600]±1 ms	20 to 3900 Hz

Note: As a Responder the Load type configuration is inactive.

Note: For Analog 2-wire, EGEN requires an allotment of time to allow for 2-wire interface calibration (~ 6 seconds). So when performing an echo sounder test to an echo gene on a 2-wire circuit, the lead delay time on the echo sounder must allow for calibration. If lead delay is not long enough, echo gen will not complete its calibration cycle and echo emulation will malfunction thus reporting incorrect results.

Create a Echo Generator Test (default: responder).

Command: **echogen**	
Parameters	echogen [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-lvl1] [-dly1] [-lvl2] [-dly2] [-g168] [-gsm] [-loop] [-pkt] [-jit] [-tone] [-hoth] [-dbl] [-bias]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-ecd	Enable EC Disable Tone(Optional)
-lvl1	1st Echo Level (dBm) {-10}(Optional) -50 to 5
-dly1	1st Echo Delay (ms) {100}(Optional) 24 to 500
-lvl2	2nd Echo Level (dBm) {no 2nd echo}(Optional) -50 to 5
-dly2	2nd Echo Delay (ms) {no 2nd echo}(Optional) 24 to 500
-g168	Dispersion=G168 Model# {none}(Optional) 1 to 8
-gsm	Dispersion Model=GSMFR {none}(Optional)
-loop	Dispersion Model=Loopback {none}(Optional)
-pkt	Dispersion Model=Packet Loss (%) {none}(Optional) 1 to 90
-jit	Dispersion Model=Packet Jitter (ms) {none}(Optional) 1 to 1000
-tone	Dispersion Scale Type {css}(Optional)
-hoth	Sig Gen=Hoth {none}(Optional) -100 to 0
-dbl	Sig Gen=CSS DblTalk {none}(Optional) -100 to 0
-bias	Sig Gen=DC Bias {none}(Optional) -100 to 0

(continued on next page)

Discussion:

The default is a single echo of -10 dB at 100ms with no dispersion. For details on the G.168 dispersion models, dispersion scale type, Hoth noise, or CSS Double-Talk see the ITU G.168 document, and/or the 'G.168 White Paper' available at www.sageinst.com The 'gsm' dispersion model is a GSM Full-Rate vocoder. The 'packet loss' and 'packet jitter' are useful for simulating/adding known impairments in a circuit. The 'loopback' is a true digital loopback with no level adjustment, but with a delay specified by the first echo.

Examples:

Create an echo generator responder test with a single echo of -12 dB at 53 ms on interface #1 resource #3: *echogen -if1 -rn3 -lvl1 -12 -dly1 53*

Create an echo generator responder test with a single default echo on interface 4 resource 5: *echogen -if 4 -rn 5*

Setting Echo Dispersion using G.168 Models

The following G.168 echo path models are used with the SAGE 966R Echo Generator test. The echo path is simulated by a linear digital filter with the scaling factor K_i as referenced in the table below. The eight G.168 models represent echo paths with various dispersion characteristics and different time widths. For tests that use CCS (Composit Source Signal) or white noise as the scaling factor the values of K_i are provided in the table below.

$$g(k) = (10^{-ERL / 20} K_i) m_i (k-\S)$$

Echo Path Model	Scaling Factor K_i	Minimum ERL for CCS (dB)*
1	1.39×10^{-5}	6
2	1.44×10^{-5}	6.55
3	1.52×10^{-5}	6
4	1.77×10^{-5}	6
5	9.33×10^{-6}	6
6	1.51×10^{-5}	6
7	2.33×10^{-5}	11.06
8	1.33×10^{-5}	9.27

* A minimum ERL value of 6 db should be used in the tests for echo path models 1, 3, 4. 5 and 6. For echo path models 2, 7 and 8 the minimum ERL values used in the tests should be, respectively, 6.55 db, 11.06 db and 9.27 db. This ensures that the magnitude response of the scaled echo-path g(k) does not exceed 0 db over the appropriate frequency range.

For tests that use Tones as the scaling factor the values of K_i are provided in the table below.

Echo Path Model	Scaling Factor K_i	Minimum ERL for Tones (dB)*
1	1.22×10^{-5}	6
2	6.78×10^{-6}	6
3	9.66×10^{-6}	6
4	1.07×10^{-5}	6
5	7.05×10^{-6}	6
6	8.60×10^{-6}	6
7	6.58×10^{-6}	6
8	4.58×10^{-6}	6

* A minimum ERL value of 6 db should be used in the tests for all 8 echo path models. Each scaling factor is used to limit the maximum of the magnitude response to the chosen ERL value.

Single-talk CSS: Composite-Source-Signal. This is the signal used in most of the tests for G.168. In time-domain, it consists of 3 portions, the active voice portion, the random noise portion and the silence (pause)p ortion. The exact duration,power-spectral-density and peak-to-RMS ratio characteristics are specified in ANNEX C of G.168

See also the "Echo Sounder & Echo Generator" White Papers available via www.sageinst.com

INMD P.561

Specifications

Interface	Range	Accuracy
TDM	0 to 511 ms	±one frame of uncertainty

INMD stands for In-service Non-intrusive Measurement Device. It is a passive voice quality monitoring method based on ITU-T P.56. Two types of measurements are covered by INMD: **1, speech and noise characterization; 2, echo characterization.** Sage's current implementation of INMD on the 966R platform focuses only on echo characterization. More specifically, once the presence of echo is detected, Sage's INMD in the 966R will report in real time the detected echo level and echo delay. A graphical snapshot of the reference and echo signals is also displayed on the main test window as further visual confirmation. If the monitored DS1 are PRI-ISDN lines, then the source and destination phone numbers associated with the monitored DS0 channel are also presented. Simply speaking, INMD detects echo by principle of cross-correlation. More specifically, as implemented in the SAGE 966R, INMD has an internal signal analyzing window of 256ms long (2048 samples at 8000Hz sampling rate). For detailed INMD P.561 network connection and operation principles see the link "Information in SAGE's P.561 INMD Test" found at **www.sageinst.com/960_B_Tech.html.**

Create an INMD (passive echo monitor) test. Requires Dual Monitor mode forT1/E1.

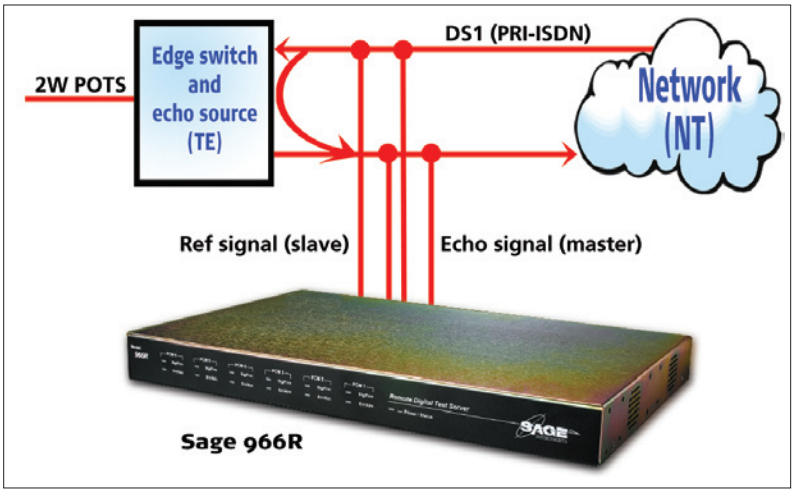
Command: **inmd**	
Parameters	inmd [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)

Example:

Create inmd tests on interface #1 resources #1-23 and log the results to inmd.log (assumes the interface is configured for Dual-Monitor Mode):

INMD P.561 Test Configuration

When using INMD, a user should connect Sage's 960 to the network as shown.



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INMD P.561 *(continued)*

The 966R has four DS1 (T1/E1/ISDN) spans, numbered as 1, 2, 3 and 4 with Rx and Tx ports (Use only the Rx ports to make the connections). Internally, 1 and 2 are a pair controlled by one embedded processor, whereas 3 and 4 are another pair controlled by another embedded processor.

Since INMD entails precise relative delay measurement between two input signals, Sage's 966R must be configured in the following ways:

1. Two DS1 spans are used for INMD, although only the receiving ports need to be connected. The two DS1 spans must be either the 1 and 2 pair, or the 3 and 4 pair. Other combinations such as 1 and 4 or 2 and 3 etc are not allowed.

2. The chosen DS1 pair must be configured to "DUAL MONITOR" mode. When performing span configuration through 966R's GUI, one only needs to (and must) configure the first span (1 or 3) of each DS1 pair. The partner DS1 span (2 or 4) will be configured automatically for you. A user configuration on the second DS1 span (2 or 4) has no effect. In "DUAL MONITOR" mode, the internal software will always set the DS1 clock source to "EXTERNAL" clock regardless what the user selects on the GUI.

3. If the DS1 lines being monitored are PRI-ISDN lines, then the D-channel must be specified correctly when performing the span configuration in order for INMD to intercept the source and destination phone numbers associated with the DS0 channel(s) being monitored. If one is also interested in decoding all the ISDN call messages, one should also specify the TE and NT modes correctly. As in "TERMINATE" mode, the 966R DS1 span should be set to match the incoming NT or TE mode. For example, as illustrated if the signal goes into the receiving port of 1 is from the NT equipment, then 966R's PCM1 must be set to TE mode. Internally, 2 will automatically be set to NT mode to match the signal from the TE equipment.

MoIP Director

Purpose and Function

MoIP stands for Modem over IP. Sage Instruments designed this IP Telephony Service Transparency and E-model Test to specifically verify a gateway or IADís ability to handle a MoIP call or a VoIP call. More specifically, the test sends standard-based precursor signature tones by emulating a FAX call, a V34/V90 modem call or a voice call to test the gateway's call discrimination capability. After the signature tones, the test then measures the round-trip delay as the delay is a good indicator of the internal jitter buffer size. The test then starts simplex, full-duplex or half-duplex packet network impairments test by measuring in detail each individual packet loss event and its duration, and each individual voice jitter (gapping or jerking) event and its duration. The signal level change (gain) is also measured, and the codec type (PCM, ADPCM or VOCODER) is also detected. When voice test mode is chosen, echoes (in terms of levels and delays) are also measured from both directions using Sageís proprietary Echo Sounder algorithm. All of the measured parameters (round-trip delay, vocoder type, packet losses and echoes) are then used as inputs into the ITU-T G.107 E-model to produce a transmission rating factor R value, and the derivative GoB (Good or Better), PoW(Poor or Worse) and E-MOS (E-model-based mean-opinion- score) numbers. With this test, a user can quickly determine whether or not the device and network under test can handle various MoIP or VoIP calls.

Create a MoIP Director Test.

Command: **moipd**	
Parameters	moipd [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-voi] [-vfx] [-v34] [-dur] [Tx Level (dBM) {-10}]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-voi	Voice Mode(Optional)
-vfx	FAX Modem (default)(Optional)
-v34	V34/V90 Modem(Optional)
-dur	Test Duration(s) {25}(Optional) 10 to 1000
Tx Level	[Tx Level (dBM) {-10}](Optional) -30 to 0

Example:

Run a MoIP Director test once on interface #2 resource #4 to 351-2245 and log the results to moip.csv:

moipd -if 2 -rn 4 -dir 1 -dn 3512245 -log moip.csv

See also the ' New IP Telephony Transparency Test, MoIP, Fax, Data & Voice White Paper' available via www.sageinst.com.

MoIP Responder

Purpose and Function

(See MoIP Director). See also the ' New IP Telephony Transparency Test, MoIP, Fax, Data & Voice White Paper' available via www.sageinst.com.

Create a MoIP Responder Test.

Command: **moipr**	
Parameters	moipr [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)

Discussion:

See the Purpose and Function Discussion on the MoIP Director (previous page), also found via command line 'help moipd'.

Example:

Create a moipr receiver (responder) test to answer incoming MoIP calls on interface #1 resources 1-10:

moipr -if1 -rn1-10

FAX Transmit/Receive Tests

Sage's Fax Emulator (SFE) is a test feature that emulates both a realistic FAX transmitter and a FAX receiver. By FAX transmitter, we mean the FAX machine that originates a call, and sends the FAX pages. By FAX receiver, we mean the FAX machine that answers the call, and receives the FAX pages. To use SFE, one normally originates a call from Sage's FAX transmitter to another FAX machine or Sage's FAX receiver across the network under test. Sage's FAX transmitter will then communicate with the destination FAX machine or Sage's FAX receiver with the protocols specified in ITU-T T.30. Two test pages will be sent from the transmitter to the receiver. The test pages are encoded according to formats documented in ITU-T T.4. While the test is going on, Sage's FAX emulators will report in real time the test progress, such as what signal is being sent; what signal is being received; whether or not a certain stage is being retried; whether or not an unexpected invalid protocol packet is received; whether or not certain timing errors have occurred (certain protocol packets not received within allowable time frame), and whether or not the page transmission has succeeded etc. See **www.sageinst.com for** detailed SFE test information.

Create a Fax Transmitter Test (default: director).

Command: **faxtx**	
Parameters	faxtx [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-v27] [Tx Level (dBM) {-10}]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-v27	V27(Optional)
Tx Level	[Tx Level (dBM) {-10}](Optional) -20 to 0

Example: Start a FAX (transmitter) test to destination #332-2345 with default settings on resource #2 of interface #1: *faxtx -if 1 -rn 2 -dn 3322345*

Create a Fax Receiver test (default: responder).

Command: **faxrx**	
Parameters	faxrx [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)

Example: Create a FAX Receiver (responder) test on resource #1 of interface #3 that logs the results to file named faxrx.csv: *faxrx -if3 -rn1 -log faxrx.csv*

Digit Receiver Test

Sage's Digit Analyzer verifies received DTMF/MF digits with displayed On/Off times, frequency, and level for each digit received. Digit receiver detects ANSI Standards and RFC-2833 Digits. 'Pre-Digit Timeout': If no incoming call setup digits are detected within this time, call setup proceeds without them. 'Post-Digit Timeout': Duration to wait after last call-setup digit before proceeding with call-setup.

Create a Digit Receiver test that parses incoming digits. Min level = -25dBm, min duration = 40 ms, max freq deviation = 10 Hz Responder by default.

Command: **digrecv**	
Parameters	digrecv [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-pre] [-post]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-pre	Pre-Digit Timeout (ms) {3000}(Optional) 0 to 60000
-post	Post-Digit Timeout (ms) {3000}(Optional) 0 to 60000

Example:

Create a digit receiver responder on channel 1 of span 2 that logs the digits to dig.csv:
digrecv -if 2 -rn 1 -log dig.csv

The results file will look like the following:

Date,Time,Test Name,Span Name,Channel(s), Digit, Type(MFlDTMF), Stage('-'l'+') , lvl1, lvl2, freq1, freq2, off, on

08/08/2005,16:22:39,Digit Receiver,pcm1,1, 7, DTMF, -, -7, -7, 852, 1209, 2371, 50
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 8, DTMF, -, -7, -7, 852, 1336, 50, 50
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 9, DTMF, -, -7, -7, 852, 1477, 49, 51
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 6, DTMF, -, -7, -7, 770, 1477, 50, 50
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 5, DTMF, -, -7, -7, 770, 1336, 49, 51
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 4, DTMF, -, -7, -7, 770, 1209, 49, 51
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 1, DTMF, -, -7, -7, 697, 1209, 49, 51
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 2, DTMF, -, -7, -7, 697, 1336, 50, 50
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 3, DTMF, -, -7, -7, 697, 1477, 50, 50
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 1, DTMF, -, -7, -7, 697, 1209, 50, 50
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 2, DTMF, -, -7, -7, 697, 1336, 49, 51
08/08/2005,16:22:39,Digit Receiver,pcm1,1, 3, DTMF, -, -7, -7, 697, 1477, 49, 51
08/08/2005,16:22:41,Digit Receiver,pcm1,1, 7, DTMF, +, -7, -7, 852, 1209, 1360, 57
08/08/2005,16:22:42,Digit Receiver,pcm1,1, 3, DTMF, +, -7, -7, 697, 1477, 2263, 56
08/08/2005,16:22:42,Digit Receiver,pcm1,1, 5, DTMF, +, -7, -7, 770, 1336, 774, 56

The 'Stage' indicated in the results indicates if the digit was captured during call setup (a '-') or after the call is up (a '+'). The 'off' time is the ms elapsed since the last event (call setup beginning event or last digit trailing edge). The on time is the duration of the digit, in milliseconds.

Digit Sender Test

Purpose and Function

Sageís Digit Sender Envelope Testing allows a user to send RFC-2833 Digits with settable frequency, level, and On/Off times. Figure 112 shows the main test screen with the "Digit Sender" test selected and saved. When clicked the three (3) "Configure" buttons down the center of the main screen display the test set-up windows below and at right.

Create a Digit Sender test (default: director) that sends digits once the call is up. Digit parameters do not effect call setup digits, only digits sent after call is up.

Command: **digsend**	
Parameters	digsend [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-on] [-off] [-lvl1] [-lvl2] [-df1] [-df2] [-MF] # to Send
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF} (Optional)
-on	Digit On Duration (ms) {75}(Optional) 41 to 30000
-off	Digit Off Duration (ms) {75}(Optional) 41 to 30000
-lvl1	Level 1 (dBm) {-7}(Optional) -30 to -3
-lvl2	Level 2 (dBm) {-7}(Optional) -30 to -3
-df1	Freq 1 Deviation (Hz) {0}(Optional) -100 to 100
-df2	Freq 2 Deviation (Hz) {0}(Optional) -100 to 100
-MF	Send MF Digits during call {DTMF}(Optional)
# to send	Characters without whitespace

Example:
Dial 338-2429 on interface #1 resource #5 using the default call setup sequence, then send 555-1212 with 90 ms on duration and 50 ms off duration.

digsend -if 1 -rn 5 -dn 3382429 -on 90 -off 50 5551212

10x Director Test

Purpose and Function

An implementation of the 100, 102, & 105 tests described in the AT&T 'Compatibiliy Bulletin No. 106' (aka CB106) of December, 1981. The standard 105 test includes the following 9 individual user selectable tests:

1. Loss at 1004 Hz with 0 dBm TX level
2. Loss at 404 Hz with -16 dBm TX level (a 'gain/slope' test)
3. Loss at 1004 Hz with -16 dBm TX level (a 'gain/slope' test)
4. Loss at 2804 Hz with -16 dBm TX level (a 'gain/slope' test)
5. C-message filter-weighted noise measurement.
6. C-message filter-weighted and tone-notched noise measurement.
7. ERL: echo return loss
8. SRL: singing return loss
9. SRH: singing return loss high

At least one test MUST be specified in 105 Mode. Type 100 & 102 directors will ignore any selected tests, performing as dictated by CB106: Type 100 measures loss, C-notch, Cmsg, ERL, SRL and SRH Type 102 mesures (repeatedly) loss, C-notch and Cmsg.

A parameter is provided to adjust the director-responder communication (telemetry) level in the presence excessive gain or attenuation. Also, to inter-operate with responder implementations that are slow to receive subsequent commands, a parameter is exposed to alter the inter-test delay.

Note that due to the required telemetry, results from the far end have the following constraints:

C-Message: >= 15 bBrnC
C-Notch: >= 34 dBrnC
ERL, SRL, SRH: <= 40 dB

In the interests of compatibility & consistency the near end results impose the same constraints, even though our modern precision measurement equipment can do much better.

10x Director Test *(continued on next page)*

10x Director Test *(continued)*

Create a 100, 102, or 105 Director Test.

Command: **10xd**	
Parameters	10xd [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-all] [-gsl] [-loss01004] [-loss404] [-loss1004] [-loss2804] [-cmsg] [-cnotch] [-erl] [-srl] [-srh] [-comlvl] [-pause] [-t100] [-t102]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-all	Perform All Tests(Optional)
-gsl	Perform Gain/Slope Tests(Optional)
-loss01004	Perform Loss 1004Hz 0 dBm(Optional)
-loss404	Perform Loss 404Hz -16 dBm(Optional)
-loss1004	Perform Loss 1004Hz -16 dBm(Optional)
-loss2804	Perform Loss 2804Hz -16 dBm(Optional)
-cmsg	Perform C-message noise(Optional)
-cnotch	Perform C-notch noise(Optional)
-erl	Perform ERL(Optional)
-srl	Perform SRL(Optional)
-srh	Perform SRH(Optional)
-comlvl	Comm Level (dB) {-10}(Optional) -20 to 0
-pause	Inter-Test pause (ms) {100}(Optional) 10 to 1000
-t100	100-type Director {105}(Optional)
-t102	102-type Director {105}(Optional)

Examples:

Start a 105 Test to destination #332-2345 and run all nine tests on resource #2 of interface #1:

10xd -if 1 -rn 2 -dn 3322345 -all

10x Responder Test

Purpose and Function

An implementation of the 105 tests described in the AT&T 'Compatibiliy Bulletin No. 106' (aka CB106) of December, 1981. Also, implements type 100, 102, 108 responders.

The standard 105 test includes the following 9 individual tests:

1. Loss at 1004 Hz with 0 dBm TX level
2. Loss at 404 Hz with -16 dBm TX level
3. Loss at 1004 Hz with -16 dBm TX level
4. Loss at 2804 Hz with -16 dBm TX level
5. C-message filter-weighted noise measurement.
6. C-message filter-weighted and tone-notched noise measurement.
7. ERL: echo return loss
8. SRL: singing return loss
9. SRH: singing return loss high

The 100-type responder transmits 1004 Hz for 5.5 seconds, the becomes a quiet termination. The 102-type responder transmits 1004 Hz at 0 dBm, 9 seconds on, 1 second off. The 108-type responder is a loopback.

A parameter is provided to adjust the director-responder communication (telemetry) level in the presence excessive gain or attenuation. Also, to inter-operate with director implementations that are slow to receive results, a parameter is exposed to delay sending the results back.

Note that due to the required telemetry, results from the far end have the following constraints:

C-Message: >= 15 bBrnC
C-Notch: >= 34 dBrnC
ERL, SRL, SRH: <= 40 dB

In the interests of compatibility & consistency the near end results impose the same constraints, even though our modern precision measurement equipment can do much better.

10x Responder Test *(continued on next page)*

10x Responder Test *(continued)*

Create a 100, 102, 105 (default), or 108 Responder Test.

Command: **10xr**	
Parameters	10xr [-dn] [-sn] -if [-rn] [-log] [-dir] [-resp] [-mf] [-t100] [-t102] [-t108] [-comlvl] [-pause] [-tptdur] [-dur]
-dn	destination(Optional) Characters without whitespace
-sn	source #(Optional) Characters without whitespace
-if	IF# 1 to 6
-m	Resource#(Optional) 1 to 255
-log	Log File(Optional) Characters without whitespace
-dir	Be Director: # times to run {0}(Optional) 0 to 999
-resp	Be Responder(Optional)
-mf	Send MF call setup digits (CAS only) {DTMF}(Optional)
-t100	100-type Responder {105}(Optional)
-t102	102-type Responder {105}(Optional)
-t108	108-type Responder {105}(Optional)
-comlvl	Comm Level (dB) {-10}(Optional) -20 to 0
-pause	Results pause (ms) {100}(Optional) 10 to 1000
-tptdur	Sent TPT Duration (ms) {1500}(Optional) 1000 to 5000
-dur	Test Duration (sec) {0(forever)}(Optional) 0 to 1000

Example:

Start a 105 Responder on resource #2 of interface #1:

10Xr -if 1 -rn 2

966R Warranty

Product Warranty

Sage Instruments products are warranted to be free from defects in materials or workmanship for a period of one year from the date of shipment. Sage Instruments further warrants that each product will execute its software programming instructions. During the one year warranty period, Sage will, at its option and expense, either repair or replace products which prove to be defective.

Limitation Of Warranty

This warranty does not cover repairs for damages from accident, misuse (including modification to or addition of software), tampering, improper maintenance, repair by anyone not authorized by Sage Instruments, or shipment in unapproved packaging. Outof-warranty repairs performed by Sage Instruments are billed to the customer. Sage Instruments does not warrant that the operation of its products will be continuous or error free.

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Sage Instruments products that are repaired during the initial one year warranty period by Sage Instruments or its authorized representative are further warranted for a period of 90 days from the date of shipment from the repair facility. All out-of-warranty repairs performed by Sage Instruments are warranted for a period of 90 days.

Shipping Instructions

To exercise the Sage Instruments warranty, contact a Sage Instruments customer service representative and obtain a returned material authorization number RNA). Include a detailed description of the problem and the conditions and circumstances under which the symptoms occurred. Ship the product in its original packaging, or in packaging approved by Sage Instruments. If unapproved packaging is used, this warranty is void. Shipping charges, duties, and taxes must be prepaid. Return shipping to the customer is paid by Sage Instruments.

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